# Complete Summary

## GUIDELINE TITLE

Chronic obstructive pulmonary disease.

## BIBLIOGRAPHIC SOURCE(S)

Institute for Clinical Systems Improvement (ICSI). Chronic obstructive pulmonary disease. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2005 Dec. 66 p. [122 references]

## GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Chronic obstructive pulmonary disease. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2004 Dec. 67 p.

## ** REGULATORY ALERT **

## FDA WARNING/REGULATORY ALERT

Note from the National Guideline Clearinghouse: This guideline references a drug(s) for which important revised regulatory and/or warning information has been released.

On November 18, 2005, the U.S. Food and Drug Administration (FDA) notified manufacturers of Advair Diskus, Foradil Aerolizer, and Serevent Diskus to update their existing product labels with new warnings and a Medication Guide for patients to alert health care professionals and patients that these medicines may increase the chance of severe asthma episodes, and death when those episodes occur. All of these products contain long-acting beta2-adrenergic agonists (LABA). Even though LABAs decrease the frequency of asthma episodes, these medicines may make asthma episodes more severe when they occur. A Medication Guide with information about these risks will be given to patients when a prescription for a LABA is filled or refilled. See the FDA Web site for more information.

## COMPLETE SUMMARY CONTENT

## SCOPE

### DISEASE/CONDITION(S)

Chronic obstructive pulmonary disease (COPD)

### GUIDELINE CATEGORY

Diagnosis
Evaluation
Management
Treatment

### CLINICAL SPECIALTY

Family Practice
Internal Medicine
Pulmonary Medicine
Thoracic Surgery

### INTENDED USERS

Advanced Practice Nurses
Allied Health Personnel
Health Care Providers
Health Plans
Hospitals
Managed Care Organizations
Nurses
Physician Assistants
Physicians
Respiratory Care Practitioners

### GUIDELINE OBJECTIVE(S)

- To increase the use of spirometry in the diagnosis of patients with chronic obstructive pulmonary disease (COPD)
- To increase the number of patients with COPD who receive information on the options for tobacco cessation and information on the risks of continued smoking
- To reduce COPD exacerbation requiring Emergency Department (ED) evaluation or hospital admission

- To increase the appropriate use of pharmacotherapy prescribed for patients with COPD
- To increase patients' education and management skills with COPD
- To increase the number of patients with COPD presenting with an acute exacerbation that have an oxymetric evaluation

## TARGET POPULATION

Patients with symptoms of stable chronic obstructive pulmonary disease (COPD) as well as acute exacerbations of COPD

## INTERVENTIONS AND PRACTICES CONSIDERED

### Stable Chronic Obstructive Pulmonary Disease

#### Evaluation/Diagnosis

1. Assessment of symptoms and/or risk factors (including tobacco use) for chronic obstructive pulmonary disease (COPD)
2. Medical history
3. Physical examination
4. Spirometry (pre-and post-bronchodilator)
5. Chest radiograph
6. Establish severity of COPD

#### Management/Treatment of Stable COPD

1. Step Care - Primary pharmacologic approach
    - Inhaled short-acting bronchodilator alone
    - Short-acting bronchodilator plus scheduled dosing of tiotropium (Spiriva®), albuterol (Proventil®, Ventolin®) or albuterol plus ipratropium (Combivent®) or formoterol (Foradil®) or ipratropium (Atrovent®) or salmeterol (Serevent®) or levalbuterol (Xopenex®)
    - Adjunctive oral corticosteroid (prednisone)
    - Inhaled corticosteroids (beclomethasone, budesonide, flunisolide, fluticasone, triamcinolone acetonide)
    - Theophylline as adjunctive therapy with inhaled bronchodilators
2. Other pharmacologic treatment
    - Immunization with influenza and pneumococcal vaccine
    - Mucolytics
    - Antiviral agents (amantadine [Symmetrel®]), rimantadine [Flumadine®], zanamivir [Relenza®],oseltamivir [Tamiflu®])
    - Oral beta agonists

    Note: The following treatments are discussed but not recommended: regular use of antitussives, leukotriene modifiers, routine use of antibiotics

3. Non-pharmacologic treatment: exercise, patient education, pulmonary rehabilitation program for moderate or severe COPD
4. Assessment for and treatment of (as indicated) hypoxemia and hypercapnia: arterial blood gas (ABG) measurement, pulse oximetry, oxygen therapy

5. Long-term management: follow-up visits, education, evaluation and monitoring of comorbidities, and referral to pulmonary specialist
6. Surgery (lung volume reduction for emphysema, bullectomy, and lung transplantation)
7. Discussion with patients regarding advanced health care directives

Exacerbation of COPD

Evaluation/Diagnosis

1. Assessment of symptoms of COPD exacerbation
2. Medical history
3. Physical examination
4. Chest radiograph
5. Laboratory tests including ABG, theophylline level, and white blood cell count

Note: In patients with COPD exacerbation, there is not a good relationship with spirometry. For that reason, $O_2$ saturation should be monitored. Additional laboratory testing, electrocardiography, and echocardiography were discussed but not recommended.

Treatment

1. Bronchodilators such as albuterol, albuterol plus ipratropium bromide, levalbuterol
2. Steroids (inhaled and oral)
3. Antibiotics (first-line agents such as amoxicillin, trimethoprim/sulfamethoxazole, doxycycline, or second line antibiotics such as second-generation cephalosporins, azithromycin, clarithromycin, and amoxicillin/clavulanate)
4. Oxygen delivery
5. Follow-up
6. Hospital admission (if no improvement)

## MAJOR OUTCOMES CONSIDERED

- Outcomes of treatment (e.g., symptom relief, exercise tolerance, frequency of exacerbations, long-term costs, forced expiratory volume in 1 second [$FEV_1$] measures, quality of life, survival)
- Morbidity and mortality related to chronic obstructive pulmonary disease (COPD)
- Adverse effects of treatment

# METHODOLOGY

## METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

## DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

2001 Version of Guideline

Searches of the medical literature on MEDLINE have been conducted by staff of the Arneson Library at Methodist Hospital in St. Louis Park, Minnesota. An initial comprehensive search was conducted in November 1999. The search focused on randomized and/or controlled trials. In addition, the following key words and filters were used when conducting the first search: diagnosis, treatment and management, chronic bronchitis, emphysema, chronic obstructive lung disease, and asthmatic bronchitis.

- The search was limited to: ages 55 and older.
- The search was sorted by: smoking status (if available).
- The search included: English-only reviews, meta-analyses, clinical trials, and evidence-based practice parameters/guidelines published from 1994-April 2001.

Subsequent targeted searches of the literature have been conducted using the same time frame and article types as the original search. Individual searches on the following keywords have been conducted and distributed to work group members researching related areas:

- Authors: T. Petty, M. King
- DNAse and chronic obstructive pulmonary disease (COPD)
- Dry powder inhalers (rotahaler, turbuhaler, etc) and COPD
- Nebulizers and COPD
- Patient education and COPD
- Use of guaifenesin (guaiacol glyceryl ether)
- Spacers and COPD
- Spirometry
- Corticosteroids and COPD

2003 Version of Guideline

Searches of the medical literature on MEDLINE have been conducted by staff of the Arneson Library at Methodist Hospital in St. Louis Park, Minnesota. The search focused on randomized and/or controlled trials. In addition, the following key words and filters were used when conducting the first search.

Keywords included: diagnosis, treatment and management, chronic bronchitis, emphysema, chronic obstructive lung disease, and asthmatic bronchitis.

The search was limited to: ages 55 and older.

The search was sorted by: smoking status (if available).

The search included: English-only reviews, meta-analyses, clinical trials, and evidence-based practice parameters/guidelines published from September 2002-October 2003.

Subsequent targeted searches of the literature have been conducted using the same time frame and article types as the original search. Individual searches on the following keywords have been conducted and distributed to work group members researching related areas:

- Dry powder inhalers (rotahaler, turbuhaler, etc) and COPD
- Nebulizers and COPD
- Patient education and COPD
- Use of guaifenesin (guaiacol glyceryl ether)
- Spacers and COPD
- Spirometry
- Corticosteroids and COPD
- Levalbuterol and COPD

2004 and 2005 Versions of Guideline

Not stated

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Key conclusions (as determined by the work group) are supported by a conclusion grading worksheet that summarizes the important studies pertaining to the conclusion. Individual studies are classed according to the system presented below, and are designated as positive, negative, or neutral to reflect the study quality.

Conclusion Grades:

Grade I: The evidence consists of results from studies of strong design for answering the question addressed. The results are both clinically important and consistent with minor exceptions at most. The results are free of any significant doubts about generalizability, bias, and flaws in research design. Studies with negative results have sufficiently large samples to have adequate statistical power.

Grade II: The evidence consists of results from studies of strong design for answering the question addressed, but there is some uncertainty attached to the conclusion because of inconsistencies among the results from the studies or because of minor doubts about generalizability, bias, research design flaws, or adequacy of sample size. Alternatively, the evidence consists solely of results from weaker designs for the question addressed, but the results have been confirmed in separate studies and are consistent with minor exceptions at most.

Grade III: The evidence consists of results from studies of strong design for answering the question addressed, but there is substantial uncertainty attached to the conclusion because of inconsistencies among the results of different studies or because of serious doubts about generalizability, bias, research design flaws, or

adequacy of sample size. Alternatively, the evidence consists solely of results from a limited number of studies of weak design for answering the question addressed.

Grade Not Assignable: There is no evidence available that directly supports or refutes the conclusion.

Study Quality Designations:

The quality of the primary research reports and systematic reviews are designated in the following ways on the conclusion grading worksheets:

Positive: indicates that the report or review has clearly addressed issues of inclusion/exclusion, bias, generalizability, and data collection and analysis.

Negative: indicates that these issues (inclusion/exclusion, bias, generalizability, and data collection and analysis) have not been adequately addressed.

Neutral: indicates that the report or review is neither exceptionally strong nor exceptionally weak.

Not Applicable: indicates that the report is not a primary reference or a systematic review and therefore the quality has not been assessed.

Classes of Research Reports:

A. Primary Reports of New Data Collection:

   Class A:

   - Randomized, controlled trial

   Class B:

   - Cohort study

   Class C:

   - Nonrandomized trial with concurrent or historical controls
   - Case-control study
   - Study of sensitivity and specificity of a diagnostic test
   - Population-based descriptive study

   Class D:

   - Cross-sectional study
   - Case series
   - Case report

B. Reports that Synthesize or Reflect upon Collections of Primary Reports:

Class M:

- Meta-analysis
- Systematic review
- Decision analysis
- Cost-effectiveness analysis

Class R:

- Consensus statement
- Consensus report
- Narrative review

Class X:

- Medical opinion

## METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review with Evidence Tables

## DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

## METHODS USED TO FORMULATE THE RECOMMENDATIONS

Not stated

## RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

## COST ANALYSIS

The guideline developers reviewed published cost-analyses.

## METHOD OF GUIDELINE VALIDATION

Clinical Validation-Pilot Testing
Internal Peer Review

## DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Institute Partners: System-Wide Review

The guideline draft, discussion, and measurement specification documents undergo thorough review. Written comments are solicited from clinical,

measurement, and management experts from within the member medical groups during an eight-week period of "Critical Review".

Each of the Institute's participating medical groups determines its own process for distributing the guideline and obtaining feedback. Clinicians are asked to suggest modifications based on their understanding of the clinical literature coupled with their clinical expertise. Representatives from all departments involved in implementation and measurement review the guideline to determine its operational impact. Measurement specifications for selected measures are developed by the Institute for Clinical Systems Improvement (ICSI) in collaboration with participating medical groups following general implementation of the guideline. The specifications suggest approaches to operationalizing the measure.

### Guideline Work Group: Second Draft

Following the completion of the "Critical Review" period, the guideline work group meets 1 to 2 times to review the input received. The original guideline is revised as necessary and a written response is prepared to address each of the suggestions received from medical groups. Two members of the Respiratory Steering Committee carefully review the Critical Review input, the work group responses, and the revised draft of the guideline. They report to the entire committee their assessment of two questions: (1) Have the concerns of the medical groups been adequately addressed? (2) Are the medical groups willing and able to implement the guideline? The committee then either approves the guideline for pilot testing as submitted or negotiates changes with the work group representative present at the meeting.

### Pilot Test

Medical groups introduce the guideline at pilot sites, providing training to the clinical staff and incorporating it into the organization's scheduling, computer, and other practice systems. Evaluation and assessment occurs throughout the pilot test phase, which usually lasts for three months. Comments and suggestions are solicited in the same manner as used during the "Critical Review" phase.

The guideline work group meets to review the pilot sites' experiences and makes the necessary revisions to the guideline, and the Respiratory Steering Committee reviews the revised guideline and approves it for implementation.

## RECOMMENDATIONS

### MAJOR RECOMMENDATIONS

Note from the National Guideline Clearinghouse (NGC) and the Institute for Clinical Systems Improvement (ICSI): In addition to updating their clinical guidance, ICSI has developed a new format for all guidelines. Key additions and changes include: combination of the annotation and discussion section; the addition of "Key Points" at the beginning of most annotations; the inclusion of references supporting the recommendations; and a complete list of references in the Supporting Evidence section of the guideline. For a description of

what has changed since the previous version of this guidance, refer to "Summary of Changes -- December 2005."

The recommendations for the diagnosis and management of stable chronic obstructive pulmonary disease (COPD) are presented in the form of an algorithm with 15 components, accompanied by detailed annotations. An algorithm is provided for Chronic Obstructive Pulmonary Disease; clinical highlights and selected annotations (numbered to correspond with the algorithm) follow.

Class of evidence (A-D, M, R, X) and conclusion grade (I-III, Not Assignable) definitions are repeated at the end of the "Major Recommendations" field.

## Clinical Highlights

1. Assess patients for symptoms and risk factors for COPD including asking about tobacco use/exposure at every visit. (Annotations #1, 2)
2. Establish diagnosis and severity of COPD through spirometry, pre-and post-bronchodilator, and chest radiograph in addition to history and physical examination. (Annotation #3)
3. After establishing severity, assess patient needs for pharmacologic and non-pharmacologic treatment and provide appropriate therapy as indicated. (Annotation #11, 12, 13)
4. Management of COPD should include an education plan suited to the patient's specific needs, encouragement of exercise, tobacco use cessation, and other behavioral changes, and monitoring of immunization status. (Annotations #2, 13)
5. A trial of inhaled steroids is indicated for symptoms not controlled by scheduled bronchodilators. (Annotation #11)
6. A course of systemic steroids is beneficial for COPD exacerbations. (Annotation #6)
7. Tiotropium offers significant advantages as a scheduled bronchodilator to patients whose symptoms are not controlled by albuterol. (Annotation #11)
8. For patients with severe symptoms, despite maximal medical therapy, lung volume reduction surgery and transplantation may be an option. (Annotation #15)
9. Patients should be regularly assessed for hypoxemia; appropriate oxygen therapy should be prescribed accordingly. (Annotation #14)
10. Physicians should discuss advance directives/health care directives and goals of care as early as possible. (Annotation #15)

## Chronic Obstructive Pulmonary Disease Algorithm Annotations

1. Symptoms of or Risk Factors for COPD

   COPD may be indicated by the presence of one of the following symptoms:

   - Chronic cough (duration greater than 3 months) with or without sputum production
   - Dyspnea with or without wheezing

COPD should also be considered if the patient has one or more of the following risk factors:

- History of tobacco use or prolonged exposure to second-hand or environmental smoke
- Asthma
- Environmental exposure to occupational dust and chemicals (e.g. cadmium)
- Alpha$_1$ - antitrypsin deficiency
- Chronic respiratory infections

2. Ask About Tobacco Use/Exposure at Every Visit

Key Points:

- Tobacco cessation and oxygen therapy are the only interventions proven to prolong survival of patients with COPD.

Ten to 15 percent of long-term smokers develop COPD with accelerated rates of decline in forced expiratory volume in one second ($FEV_1$). Advice and support from physicians and other health professionals are potentially powerful influences on tobacco cessation. According to the United States Surgeon General, tobacco use is one of the most important public health issues of our time. The National Cancer Institute, which is the primary federal agency for tobacco control, states that the keys to patient awareness and education about tobacco cessation in a clinical setting are:

ASK about tobacco use at every visit

ADVISE all users to stop

ASSESS users' willingness to make a quit attempt

ASSIST users' efforts to quit

ARRANGE follow up

Reinforcement of tobacco cessation and follow-up for patients with COPD are extremely important. Pharmacotherapy, social support, and skills training/problem solving are the key treatments for tobacco cessation. Nicotine patches, nasal sprays, inhalers, and oral medication are all available to help patients achieve cessation.

For more information about tobacco cessation, please refer to the National Guideline Clearinghouse (NGC) summary of the Institute for Clinical Systems Improvement (ICSI) Tobacco Use Prevention and Cessation for Adults and Mature Adolescents guideline and the U.S. Department of Health and Human Services Clinical Practice Guideline, "Treating Tobacco Use and Dependence."

Evidence supporting this recommendation is of classes: A, R

3. Establish Diagnosis of COPD

Key Points:

The American Thoracic Society (ATS) defines COPD as follows:

- COPD is a disease characterized by the presence of airflow obstruction due to chronic bronchitis or emphysema; the airflow obstruction is generally progressive, may be accompanied by airway hyper-reactivity, and may be partially reversible.
- Chronic bronchitis is defined as the presence of chronic productive cough for 3 months in each of two successive years in a patient in whom other causes of chronic cough have been excluded.
- Emphysema is defined as an abnormal permanent enlargement of the air spaces distal to the terminal bronchioles, accompanied by destruction of their walls and without obvious fibrosis.

The diagnosis of COPD should be suspected based on the patient's medical history and physical examination, but requires spirometry to determine the degree of airflow limitation.

Signs/Symptoms for which COPD may be suspected

- Wheezing, prolonged expiratory phase of respiration, rhonchi, and cough
- Dyspnea (exertional or at rest)
- Chronic sputum production
- Hyperinflation of the chest with increased anterior-posterior (A-P) diameter
- Use of accessory muscles of respiration
- Pursed-lip breathing
- Signs of cor pulmonale:
    - increased pulmonic component of the second heart sound
    - neck vein distention
    - lower extremity edema
    - hepatomegaly

      Note: Finger clubbing is not characteristic of COPD and should alert the clinician to another condition such as idiopathic pulmonary fibrosis (IPF), cystic fibrosis, lung cancer, or asbestosis.

Airflow obstruction is measured by spirometry and shows a reduced forced expiratory volume in one second ($FEV_1$) and $FEV_1$/FVC (forced vital capacity) ratio. Measuring pre-and post-bronchodilator spirometry is important to identify those patients with partial reversibility of airflow obstruction. Partial reversibility is defined as improvement in airflow by 12% of baseline and 200 mL after administration of a bronchodilator.

- Spirometry

Spirometry is an established and important method of measuring lung function for the diagnosis and management of patients with COPD. It is recommended for patients at risk of COPD, particularly smokers greater than 45 years of age, and for regular follow-up of patients with documented COPD.

Pre and Post-bronchodilator Forced Expiratory Volume in One Second ($FEV_1$)

Measurement of pre and post-bronchodilator $FEV_1$ is important to distinguish COPD from asthma, as treatment and prognosis differ. Factors commonly used to distinguish COPD from asthma include age of onset, smoking history, triggering factors, and occupational history.

If the quality of available spirometry is questionable, then formal spirometry in a pulmonary function test (PFT) lab should be considered. Full PFTs with lung volumes and Diffusion Capacity (DLCO) are neither recommended nor necessary to establish diagnosis or severity of COPD.

Spirometry, interpretation strategies, selection of reference values, and quality control should be performed in compliance with the Standards on Spirometry published by the American Thoracic Society (ATS) and with the ATS Statement on Standardization of Spirometry 1994 update. Refer to the original guideline document for additional details.

Although peak flow meters should not be used to diagnose or monitor COPD, monitoring of peak expiratory flow (PEF) at home and at work can be used in certain situations to determine reversibility of and variability in airway obstruction.

Evidence supporting this recommendation is of class: R

- Chest Radiograph

  A chest radiograph is recommended at the time of diagnosis to exclude other causes. The chest radiograph in COPD is often normal but may show signs of hyperinflation, a flattened diaphragm, or bullae.

- Bronchitis and Emphysema

  The airflow obstruction in COPD may be due to chronic bronchitis or emphysema. Chronic bronchitis is defined as the presence of a chronic productive cough for 3 months in each of two successive years in a patient in whom other causes of chronic cough have been excluded.

  Emphysema is defined as an abnormal permanent enlargement of the airspaces distal to the terminal bronchioles, accompanied by destruction of their walls, without obvious fibrosis. Radiographically, bullae may be visible on a chest computerized tomography scan or

occasionally on a chest radiograph. Clinically, emphysema typically presents with a non-productive or minimally-productive cough and progressive dyspnea. Since both chronic bronchitis and emphysema result in airflow limitation, management goals are similar.

- Differential Diagnosis

  In addition to asthma, possible differential diagnoses for COPD include bronchiectasis, cystic fibrosis, obliterative bronchiolitis, congestive heart failure, and upper airway lesions.

  For more information on diagnosis and treatment of asthma, please refer to the National Guideline Clearinghouse (NGC) summary of the ICSI guideline Diagnosis and Outpatient Management of Asthma.

For definition of COPD from other guidelines, recommended tools for diagnosis of COPD from other guidelines, and reversibility testing (measurement of pre- and post-bronchial dilator) refer to the original guideline document.

4. Acute Exacerbation?

Signs and symptoms of an acute exacerbation of COPD may include any of the following:

- Increased dyspnea
- Increased heart rate
- Increased cough
- Increased sputum production
- Change in sputum color or character
- Use of accessory muscles of respiration
- Peripheral edema
- Development or increase in wheeze
- Change in mental status
- Fatigue
- Fever
- Increased respiratory rate
- Decrease in $FEV_1$ or peak expiratory flow
- Hypoxemia
- Chest tightness

Change in mental status or a combination of two or more of the following new symptoms indicates a severe acute exacerbation:

- Dyspnea at rest
- Respiratory rate of >25 breaths per minute
- Heart rate of >110 beats per minute
- Use of accessory muscles of respiration

5. Evaluation

When a patient with known COPD presents with a moderate to severe acute exacerbation, the following key elements of the history, physical examination, and laboratory/radiology evaluation should be considered:

History

- Baseline respiratory status
- Present treatment regimen and recent medication use
- Signs of airway infection (e.g., fever and/or change in volume and/or color of sputum)
- Duration of worsening symptoms
- Limitation of activities
- History of previous exacerbations
- Increased cough
- Decrease in exercise tolerance
- Chest tightness
- Change in alertness
- Other non-specific symptoms including malaise, difficulty sleeping, and fatigue
- Symptoms associated with comorbid acute and chronic conditions

Physical Examination

- Measurement of heart rate and blood pressure
- Measurement of respiratory rate
- Measurement of pulse oximetry
- Measurement of temperature
- Respiratory distress
- Accessory respiratory muscle use
- Increased pulmonary findings (e.g., wheezing, decreased air entry, prolonged expiratory phase, etc.)
- Peripheral edema
- Somnolence and/or hyperactivity
- Acute comorbid conditions

Laboratory/Radiology

- Chest x-ray (in patients with suspected pneumonia)
- Arterial blood gases (ABG) (if $O_2$ saturation less than 88%, positive history of hypercapnia, questionable accuracy of oximetry, somnolence, or other evidence of impending respiratory failure [e.g., respiratory rate greater than 40 breaths per minute])
- Theophylline level (if theophylline is being utilized)
- White blood count (WBC) (in patients with suspected severe respiratory infection)
- A sputum culture and an antibiogram should be performed if an infectious exacerbation does not respond to initial antibiotic treatment

In patients with an acute COPD exacerbation, spirometry is of little value. For that reason, oximetry and/or ABG should be monitored.

There is little evidence regarding the contribution of additional laboratory testing or the usefulness of electrocardiography or echocardiography in an acute exacerbation of COPD. They may be a useful consideration in the presence of other comorbid conditions.

Evidence supporting this recommendation is of class: M, R

6. Treatment

Key Points:

- Albuterol is the preferred bronchodilator in the setting of an acute exacerbation of COPD because of its rapid onset of action.
- Ipratropium may be added to produce additive bronchodilation and allow the use of lower doses of albuterol.
- Steroids should be used in acute exacerbations.
- It is mandatory to check oxygen saturation or ABG measurement.

Bronchodilators

Albuterol is the preferred bronchodilator in the setting of an acute exacerbation of COPD because of its rapid onset of action. Serial administration is indicated until either relief of symptoms and improvement in signs of respiratory failure are achieved, or side effects of tachycardia and/or tremor develop. If clinical improvement does not occur before side effects develop, ipratropium bromide may be added to produce additive bronchodilation and allow the use of lower doses of albuterol, thus diminishing dose-dependent toxicity. However, no study has examined the benefit of using both agents concurrently. Administration of either agent by metered dose inhaler (MDI) with a spacer or by nebulization is acceptable, though the patient may be too dyspneic to retain a MDI puff effectively, or severe coughing may prevent effective employment. In such cases, nebulization is necessary and arrangement for home use should be made.

Evidence supporting this recommendation is of classes: A, M

Role of Levalbuterol (Xopenex®) in COPD

There are many theoretical advantages of levalbuterol over albuterol in the treatment of bronchospasm. Albuterol is a racemic combination of two isomers: the "R" isomer (levalbuterol) that is a potent bronchodilator, and the "S" isomer that has been shown in animal studies to counteract bronchodilation and can promote inflammation. Unfortunately, clinical studies in human subjects with bronchospasm have not consistently shown greater bronchodilation or fewer side effects of levalbuterol over equivalent doses of a racemic agent such as albuterol. In individual patients with COPD and acute bronchospasm, who demonstrate excessive tachycardia and/or tremor, ipratropium is the next bronchodilator of choice. Levalbuterol may be an acceptable alternative as a trial agent, especially in patients whose bronchospasm worsens or shows no improvement on ipratropium.

Evidence supporting this recommendation is of classes: C, R

Steroids

Studies have shown benefits of systemic steroids in the outpatient management of COPD exacerbation. Doses of oral prednisone 30 to 60 mg per day should be used for 10 to 14 days. If longer durations are needed, consider a tapering schedule. There is no need to discontinue inhaled steroids while the patient is taking oral prednisone. In fact, the inhaled steroid may serve as a "systemic-steroid-sparing-agent" and the concomitant use may minimize the dose of systemic steroids needed to diminish airway inflammation.

Evidence supporting this recommendation is of classes: A, R

Antibiotics

If the acute exacerbation of COPD is clearly post-viral, antibiotics may not be necessary. In the presence of prolonged illness, especially with purulent sputum, an antibiotic is warranted. The choice of antibiotic is controversial, and needs to be tailored to the individual situation. "First-line agents," such as amoxicillin, trimethoprim/sulfamethoxazole (TMP/SMX), and doxycycline are often effective. If the incidence of resistant organisms is 25% or higher in the community, the use of a "second-line agent" may be preferable. These second-line agents include second-generation cephalosporins, azithromycin, clarithromycin, and amoxicillin/clavulanate.

Oxygen Saturation/ABG Measurement

Oxymetric evaluation of patients with COPD exacerbations is mandatory. Patients with $O_2$ saturations of 80 to 90% on room air can be titrated with supplemental $O_2$ to a saturation level of 90% with little concern of significant hypercarbia, unless such intervention results in somnolence. In such cases, or if the $O_2$ saturation is less than 80% upon presentation, an ABG should be obtained. If the pH is less than 7.32, admission to the hospital should be arranged because of the risk of acute respiratory failure. If outpatient management has been decided upon, the patient should be ambulated to determine what $O_2$ flow is needed to maintain $O_2$ saturations at 90% while walking. Home $O_2$ then needs to be arranged.

Evidence supporting this recommendation is of classes: D

7. Positive Response to Treatment?

The following criteria may be used as evidence of improvement in COPD exacerbation:

- Decrease in cough, sputum production, fever, or dyspnea
- Decrease in respiratory rate
- Decrease in heart rate
- Decrease in accessory muscle use

- Increase in function and endurance

8. Arrange for Follow-Up

   A follow-up appointment between the primary care clinician and the patient should occur within 1 to 4 weeks to reassess management strategies and supplemental oxygen needs.

9. Admit to Hospital - Out of Guideline

   The following may be indications to consider hospital admission for an acute exacerbation of COPD:

   - Marked increase in intensity of symptoms, such as sudden development of resting dyspnea
   - History of severe COPD, especially if mechanical ventilation was required
   - Onset of new physical signs (e.g., cyanosis, peripheral edema)
   - Failure of exacerbation to respond to initial outpatient medical management
   - High risk comorbidities, pulmonary (e.g., pneumonia requiring hospitalization) or cardiac symptoms
   - Increasing hypoxemia despite supplemental oxygen
   - New or worsening $CO_2$ retention or Ph <7.32
   - Marked decrease in ability to ambulate, eat, or sleep due to dyspnea
   - History of prolonged, progressive symptoms
   - Newly occurring arrhythmias
   - Diagnostic uncertainty
   - Older age
   - Insufficient home support
   - Decrease in alertness

   Evidence supporting this recommendation is of class: M

10. Establish Severity of Stable COPD

    Key Points:

    - Both spirometry and/or signs and symptoms are used to establish severity.

    The signs, symptoms, and airflow limitation in COPD vary with the severity of the disease. The severity of COPD may be categorized according to the following:

| Category of COPD | $FEV_1$ (% predicted) | Typical Symptoms and Signs |
|---|---|---|
| Mild | 80 or greater | No abnormal signs<br><br>Cough $\pm$ sputum |

| Category of COPD | $FEV_1$ (% predicted) | Typical Symptoms and Signs |
|---|---|---|
| | | Little or no dyspnea |
| Moderate | between 80 and 50 | Breathlessness<br>(± wheeze on moderate exertion)<br><br>Cough<br>(± sputum)<br><br>Variable abnormal signs<br>(general reduction in breath sounds, presence of wheezes)<br>Hypoxemia may be present |
| Severe | 30 to 50 | Dyspnea with any exertion or at rest<br><br>Wheeze and cough often prominent<br><br>Lung hyperinflation usual; cyanosis, peripheral edema and polycythemia in advanced disease<br><br>Hypoxemia and hypercapnia are common |
| Very Severe | less than 30 | |

Table adapted from the National Heart, Lung and Blood Institute/World Health Organization (NHLBI/WHO) Global Initiative for Chronic Obstructive Lung Disease workshop summary.

Evidence supporting this recommendation is of class: R

11. Step-Care - Pharmacologic Approach for Managing Stable COPD

Key Points:

- Drug therapy is determined by severity of symptoms.

Each step in the Table below represents an intervention that should be considered only if the previous course of action fails to improve symptoms of COPD. Step 1 is an intervention that is generally associated with mild COPD. Step 2 is associated with moderate COPD. Steps 3 and 4 are associated with severe and very severe COPD.

A table of estimated comparative daily dosages for inhaled corticosteroids is attached in Annotation Appendix A, "Estimated Comparative Daily Dosage for Inhaled Corticosteroids" in the original guideline document.

Step-Care Pharmacologic Treatment of COPD

| Step | Pharmaceutical Intervention | Dosing Information and Comments |
|---|---|---|
| 1 | Inhaled short-acting bronchodilator | Short-acting beta agonist (albuterol is preferred) |

| Step | Pharmaceutical Intervention | Dosing Information and Comments |
|---|---|---|
| Consider Step 2 if symptoms persist | | 2 to 4 puffs, as needed (every 4 to 6 hours) |
| 2<br><br>Consider Step 3 if symptoms persist | Continue as needed (PRN) inhaled short-acting bronchodilator PLUS scheduled dosing of one of the following: | |
| | • Tiotropium (Spiriva®)<br>• Salmeterol* (Serevent® Discus)<br>• Formoterol* (Foradil®)<br>• Albuterol (Proventil®, Ventolin®)<br>• Ipratropium (Atrovent®)<br>• Albuterol + Ipratropium (Combivent®)<br>• Levalbuterol (Xopenex®) | • One capsule (inhaled) daily<br>• 1 puff twice daily<br>• 1 puff (12 micrograms) twice daily<br>• 2 to 4 puffs, 4 times a day<br>• 2 to 4 puffs, 4 times a day<br>• 2 to 4 puffs, 4 times a day<br>• 0.63 to 1.25 mg every 6 to 8 hours via nebulizer |
| 3<br><br>Consider Step 4 if symptoms persist | Continue therapy in Step 2 and perform corticosteroid trial<br><br>Assess symptoms before and after trial period, especially cough and sputum production. Also measure post-bronchodilator $FEV_1$ $\pm$ 6-minute walk before and after trial | Prednisone oral 30 to 40 mg/day for 2 to 4 weeks or inhaled corticosteroid at less than 2,000 micrograms for 6 to 8 weeks/day or dose equivalent of another inhaled steroid for 6 to 8 weeks<br><br>Approximately 15% of patients who undergo a corticosteroid trial will have improved symptoms and post-bronchodilator $FEV_1$ |
| *Tiotropium is the preferred scheduled bronchodilator. | | |

| Step 4: Response After Step 3? | |
|---|---|
| Positive Response: greater than or equal to 15% improvement in post-bronchodilator $FEV_1$, symptoms, $\pm$ improvement in 6-minute walk | Negative Response: less than 15% improvement in post-bronchodilator $FEV_1$ or no improvement in symptoms +/- 6-minute walk. |

| Step 4: Response After Step 3? | |
|---|---|
| Pharmaceutical Intervention: Taper off or discontinue oral corticosteroids and prescribe or continue inhaled corticosteroids.<br><br>Dosing Information for Inhaled Corticosteroids: A comparison of dosages of inhaled corticosteroids is attached in Annotation Appendix A of the original guideline document. | Pharmaceutical Intervention: Discontinue corticosteroids and consider theophylline as adjunctive therapy with inhaled bronchodilators (beta$_2$-agonists and/or anti-cholinergic)<br><br>Dosing Information for Theophylline: Therapeutic range of theophylline at a steady state has conventionally been considered to be 10 to 20 micrograms/mL, but lower serum concentrations of 5-15 micrograms/mL provide similar efficacy with a lower incidence of adverse effects.<br><br>Theophylline has a narrow therapeutic index with potentially significant adverse effects and drug interactions that must be carefully considered and closely monitored during therapy. |

Bronchodilator Medications

Summary

Albuterol is the preferred agent for as needed control of symptoms in patients with mild COPD and as an additive as needed agent to a scheduled bronchodilator in patients with more severe COPD because the onset of bronchodilator effect (15 minutes) is more rapid than ipratropium (30 to 90 minutes).

Tiotropium has been shown to be a superior scheduled bronchodilator to salmeterol and ipratropium.

As a scheduled bronchodilator, salmeterol has the main advantage of requiring only twice-daily dosing, and therefore may improve compliance.

Albuterol and ipratropium are equipotent as bronchodilators, improving dyspnea and exercise tolerance equally well. Salmeterol is a long-acting bronchodilator which is a suitable agent for scheduled administration. [Conclusion Grade II: See Conclusion Grading Worksheet - Appendix A - Annotation #11 (Pharmacological Management) in the original guideline document]

Supporting evidence is of classes: A, R

Refer to the original guideline document for additional information on bronchodilator medications and systemic and inhaled corticosteroids.

Methods of Drug Delivery

### Metered Dose Inhaler (MDI) with Spacer

Some studies support the use of spacers to obtain effective MDI drug delivery. The increased distance slows the velocity of the fine particles, increasing their chances of reaching the bronchial tree. It is of utmost importance to train and re-train patients, nurses, physicians, and pharmacists in the proper inhaler technique for optimal drug delivery. Evidence of the effectiveness of one type of spacer over another is variable and controversial.

Chlorofluorocarbons (CFCs) are freon compounds commonly used as propellants in commercial aerosols including MDIs. Concerns have been raised about the toxicity of freon and its role in depleting the ozone layer. The production of ozone-depleting substances is being phased out worldwide under terms of an international agreement. Since most MDIs in the U.S. contain CFCs as propellants, they will eventually need to be reformulated.

MDIs that use CFCs as a propellant will not be removed until sufficient alternatives exist to serve patient needs. The Food and Drug Administration (FDA) is developing strategies to ensure that patients in the U.S. who rely on MDIs to maintain their health will have continued access to an array of safe and effective treatment options.

Non-freon alternatives include hydrofluorocarbons (HFAs). These non-freon formations are well-tolerated and equally efficacious when compared with compounds containing freon.

### Dry Powder Inhaler (DPI)

DPIs are an alternative to MDIs that are strongly supported by study data. DPIs deliver drugs in dry-powder form without the use of propellants. In addition, DPIs are breath-activated, eliminating the need to synchronize inhalation with actuation.

DPIs have been developed as a response to concerns about freon toxicity. Newer DPI products deliver pure drug from self-enclosed, multiple-dose devices that help avoid the potential adverse effects of additives used in MDIs.

Refer to Table III in the original guideline document for information on contrasting features of conventional pressurized MDI and DPI.

### Nebulizers

Aerosol particle diameters range from 1 to 5 micrometers in small volume nebulizer (SVN) which are comparable with MDI or DPI. Studies have shown no difference in the efficacy of the delivery methods. Reports suggest that between 47% and 89% of adults may have unacceptable inhaler technique. Clinical situations in which nebulized therapy is preferable to either MDI or DPI include:

- Patients incapable of performing MDI or DPI maneuver

- Adults who have a vital capacity less than 1.5 times their predicted tidal volume (7mL/kg)

Aerosol therapy via nebulizer is generally considered expensive, inconvenient, and inefficient. Nebulizer therapy should be considered a second choice when compared with other modes of aerosol delivery (e.g., MDIs and DPIs).

Refer to Table IV in the original guideline document for comparison of nebulizers and MDIs.

Theophylline

Theophylline has a narrow therapeutic index with potentially significant adverse effects and drug interactions that must be carefully considered and closely monitored during therapy.

Refer to the original guideline document for additional information on theophylline.

Evidence supporting this recommendation is of classes: D, R

12. Other Pharmacologic Treatment

Antibiotics

The routine use of antibiotics is not recommended except for treatment of bacterial exacerbations of COPD.

Antitussives

Regular use of antitussives is not recommended in COPD since cough can have a significant protective effect.

Antiviral Agents

Treatments other than vaccination are available to treat influenza, but are not a substitute for vaccination unless it is contraindicated. Amantadine (Symmetrel®) and rimantadine (Flumadine®) are indicated for symptomatic treatment and prophylaxis of influenza A which is more prevalent and more severe than influenza B. If started within the first 48 hours of symptom onset, amantadine and rimantadine may reduce the duration and symptoms by 50%.

Zanamivir (Relenza®) and oseltamivir (Tamiflu®) are also available. Zanamivir must be inhaled whereas oseltamivir is available orally. Zanamivir and oseltamivir may be considered for treatment if there is an outbreak of influenza B. These medications are, however, very costly relative to their benefits.

A consumer information report from the Food and Drug Administration (FDA) regarding Relenza® and chronic lung disease issued in October, 2000,

included a caution that "some patients have had bronchospasm (wheezing) or serious breathing problems when they used Relenza®. Many, but not all, of these patients had previous asthma or chronic obstructive pulmonary disease. Relenza® has not been shown to shorten the duration of influenza in people with these diseases. Because of the risk of side effects, and because it has not been shown to help them, Relenza® is not generally recommended for people with chronic respiratory disease such as asthma or chronic obstructive pulmonary disease."

Refer to the original guideline document for information on costs of antiviral agents.

Leukotriene Modifiers

This drug class has not been adequately tested in COPD patients and cannot be recommended until additional evidence relative to its efficacy is available.

Mucolytics

In theory, reducing mucus viscosity and enhancing cough clearance or mucociliary clearance of mucus could improve pulmonary function and reduce the incidence of respiratory infections in individuals with COPD. Ideally, treatment would result in both objective (increase in $FEV_1$) and subjective (better sense of well-being) improvement for those individuals.

To date, there has been no conclusive evidence for significant improvement in pulmonary function with any of the agents studied so far. Guaifenesin is widely used as an over-the-counter expectorant but documented objective or even subjective improvement has not been consistently demonstrated. Iodinated glycerol was once thought to promote a decrease in symptoms and overall improvement in subjects with COPD, but this result could not be confirmed in subsequent investigations.

Some evidence for improvement in subjects with chronic bronchitis is present using other agents including inhaled surfactant, amiloride, hypertonic saline, N-acetylcysteine, and acetylcysteine, but for now is not substantial enough to be conclusive. Albuterol may have some effect in improving mucociliary clearance, which may add to its utility as a bronchodilator.

Evidence supporting this recommendation is of classes: A, C, R

Oral Beta Agonists

Inhaled bronchodilator therapy is preferred.

Vaccines

Influenza and pneumococcal pneumonia together are the 6th leading cause of death in the U.S. among persons 65 years of age and older. Immunization with pneumococcal and influenza vaccines are recommended by the U.S.

Public Health Service's Advisory Committee on Immunization Practices to reduce infectious complications involving the respiratory tract.

Pneumococcal

The American Thoracic Society and the U.S. Public Health Service's Advisory Committee on Immunization Practices (ACIP) recommend pneumococcal vaccine for all COPD patients. Pneumococcal vaccination is generally good for life, but revaccination may provide additional protection in certain groups. The risks of revaccination are minimal, and the ACIP recommends revaccination once for COPD patients if at least 5 years have passed since receipt of the previous dose.

Influenza

Influenza vaccine should be provided on an annual basis because of new antigens and waning immunity from the previous year. The optimal time for influenza vaccination is usually from early October through mid-November. To avoid a missed opportunity, vaccination can be done as soon as vaccine is available, but not prior to September. Vaccine may be given even after flu activity is known to be occurring in the community.

Evidence supporting this recommendation is of class: R

13. Non-Pharmacologic Treatment Applicable to All Levels of Severity

Key Points:

- Treatment of COPD should also include an education plan suited to the patient's specific needs along with encouragement of exercise.
- Pulmonary rehabilitation programs are effective in improving exercise capacity, quality of life, and perception of symptoms.
- Encourage Exercise

  Regular exercise has been shown to reduce symptoms of COPD and improve the quality of life in patients with COPD. See pulmonary rehabilitation program for moderate, severe disease. For patients who do not have access to a pulmonary rehab program, it is reasonable to prescribe a regular exercise schedule.

- Education

  Patient education for those with COPD may be complex. Education methods aimed at continuous improvement should be incorporated into educational strategies that take the long-term relationships between patients and health care professionals into account.

  Refer to the original guideline document for presentation of a Patient Education Model. The model presents core learning needs and objectives along with some examples of tools to assist individual clinicians in designing a patient education plan. This model is based on

the Transtheoretical Change Model (Prochaska Model), which emphasizes recognition of patients' stages of readiness to incorporate educational messages into long-term behavior change.

Evidence supporting this recommendation is of classes: A, C, D, M, R, X

Pulmonary Rehabilitation Program for Moderate, Severe Disease

The primary goal of pulmonary rehabilitation is to decrease respiratory symptoms and improve quality of life. Pulmonary rehabilitation, with a multidisciplinary approach including education and exercise training, should be considered for COPD patients who have functional limitations that affect their quality of life, have maximized on standard medical therapy, and are not limited by other serious or unstable medical conditions. For willing patients who are able to learn about their disease and are motivated to participate in a comprehensive rehabilitation program, selecting a program that emphasizes regular in-home exercise verified by an exercise log is strongly recommended. Long-term benefits from programs after completion have not been demonstrated except for home-based exercise programs. A summary of structures and services in pulmonary rehabilitation is attached in Annotation Appendix C "Summary of Structure and Services - Pulmonary Rehabilitation Program" of the original guideline document.

Studies of pulmonary rehabilitation programs for patients with COPD, including an ICSI Technology Assessment, found the following:

Pulmonary rehabilitation programs standardly available in the United States are effective in improving exercise capacity, quality of life, and perception of symptoms but only for the duration of the program, typically 8 to 12 weeks. Deterioration toward baseline after completion of the program can be routinely expected, unless the patient continues to participate in an exercise program. Pulmonary function measurements are not beneficially affected.

Pulmonary rehabilitation programs are generally safe for COPD patients.

There is evidence that a long term, structured exercise program can provide benefit for up to 18 months.

Supervised follow-up may be helpful in maintaining improvements although more studies are needed.

A multi-disciplinary approach, including exercise, maximizes the benefits of a pulmonary rehabilitation program when compared to a limited program focusing on education alone.

There is a need for additional research to clarify questions related to patient selection, program components (including contents, duration, intensity, and site), and long-term effects. In addition, there is a need to validate and standardize the outcome variables used to assess change.

Please refer to the ICSI Technology Assessment Report, Pulmonary Rehabilitation for Chronic Obstructive Pulmonary Disease, #32 for full discussion.

Evidence supporting this recommendation is of classes: A, C, M, R

14. Assess for Hypoxemia and Hypercapnia and Treat if Indicated

Key Points:

- Assess for hypoxemia and consider assessment for hypercapnia.

Hypoxemia

The evaluation of gas exchange status by ABG measurement is recommended for initiation of oxygen therapy as well as to determine $PCO_2$ and acid-base status. Assessment for long-term oxygen needs by arterial blood gas analysis should be considered for stable outpatients with:

1. Severe airflow obstruction
2. Symptomatic dyspnea with polycythemia, pulmonary hypertension (by electrocardiogram or echo), or altered mental status
3. Problematic heart failure
4. Severe symptoms out of proportion to the degree of airway obstruction

Pulse oximetry cannot determine acid-base status and is not considered sufficiently accurate to replace ABG measurement in an initial assessment. ABG measurement can be used to confirm the accuracy of pulse oximetry at rest and with exercise when oximetry is less reliable.

Evidence supporting this recommendation is of classes: A, C

Nocturnal Hypoxia

During sleep, even in individuals without COPD, minute ventilation decreases. In patients with COPD whose $O_2$ saturation is already low or borderline, this hypoventilation results in hypoxia, which can exacerbate or precipitate pulmonary hypertension. Sleep disruption from hypoxia or sleep apnea can induce daytime hypersomnolence and may worsen symptoms of COPD.

Risk Factors for Hypoxia During Sleep

- Severe COPD, especially with resting oxygen saturation less than 88% or exercise-induced hypoxia
- Evidence of cor pulmonale
- Daytime hypersomnolence in the absence of sleep deprivation
- Polycythemia

Evidence supporting this recommendation is of classes: A, C, D

## Screening for Nocturnal Hypoxia

Screening for nocturnal hypoxia can be done easily and inexpensively with overnight pulse oximetry in the home. The oximeter is returned to the clinic, where the overnight oximetry and heart rate data are downloaded. If a significant portion of the night's data indicates oxygen saturations below 88%, supplemental oxygen can be provided empirically at 1 to 2 L/min. Home oximetry can be repeated at that level to verify correction of hypoxia.

The patient should be referred to a sleep specialist to rule out sleep-related disordered breathing if additional abnormalities are present.

Evidence supporting these recommendations is of class: C

## Hypercapnia

In an ambulatory, stable patient with COPD, assessment for hypercapnia by ABGs should be considered in the following circumstances:

- Clinical suspicion of hypercapnia (asterixis, headache, hypersomnolence, altered mental status)
- $FEV_1$ less than 1.0
- Upon initiation of oxygen
- Morbid obesity
- Excessive daytime somnolence
- Problematic right heart failure/cor pulmonale
- Severe airflow obstruction

Carbon dioxide ($CO_2$) retention may pose a threat in patients with impaired $CO_2$ ventilatory drive. Careful titration of supplemental oxygen should be performed in these patients. A pH drop along with a rise in $PaCO_2$ with initiation of oxygen therapy or an increase in inspired oxygen concentration is usually well tolerated in the ambulatory stable patient with COPD. If hypercapnia results in a decrease in mental status, the patient may need admission to a hospital for more intensive respiratory care and monitoring.

In the unstable patient with resting hypercapnia, initiation of supplemental oxygen should be titrated upward, as there is a small risk of worsening $CO_2$ retention. Reassessment by ABG and clinical status looking for signs/symptoms of hypercapnia is suggested 30 minutes after initiation of oxygen.

Hypercapnia does not require specific therapy, but instead, therapeutic intervention should be directed at correcting the hypoxemia. Nonetheless, a pH drop along with a rise in $PaCO_2$ with initiation of oxygen therapy, or an increase in inspired oxygen concentration is usually well tolerated in the ambulatory stable COPD patient. If hypercapnia results in a decrease in mental status, the patient may need admission to a hospital for more intensive respiratory care.

These recommendations are further clarified in the NGC summary of the ICSI guideline Diagnosis and Treatment of Obstructive Sleep Apnea.

Evidence supporting this recommendation is of classes: C, R

Oxygen Therapy

Important points:

- Long-term oxygen therapy (more than 15 hours per day) improves survival and quality of life in hypoxemic patients.
- ABG measurement is recommended for initiation of oxygen therapy as well as to determine $PCO_2$ and acid-base status.
- Pulse oximetry is a good method for monitoring oxygen saturation and can be used in adjusting the oxygen flow setting.
- Indications for long-term oxygen therapy have been adopted by Medicare as reimbursement criteria. (Annotation Appendix B in the original guideline document contains a summary of Medicare Oxygen Coverage)
- Patients considered for long-term therapy may benefit from assessment by a pulmonologist.
- Supplemental long-term oxygen therapy should be provided at a flow rate sufficient to produce a resting $P_aO_2$ of >55 mm Hg, or $S_aO_2$ greater than 89%.
- Titrate liter-flow to goal at rest: add 1 L/min during exercise or sleep or titrate during exercise to goal of $S_aO_2$ greater than 89%. Titrate sleep liter-flow to 8-hour sleep of $S_aO_2$ greater than 89%.
- Consider referral for sleep evaluation if patient experiences cyclic desaturation during sleep but is normoxemic at rest.
- Recheck $S_aO_2$ or $P_aO_2$ in 1 to 3 months if hypoxia developed during an acute exacerbation. Rechecks should be performed annually if hypoxia is discovered in an outpatient with stable COPD.

Oxygen Delivery Methods

The dual-prong nasal cannula is the standard means of continuous flow oxygen delivery for the stable COPD patient with hypoxemia. It is not only well-tolerated, but is also simple and reliable. Care must be taken when assigning an estimated $FiO_2$ to patients as this low-flow system can have great fluctuations.

Reservoir cannulas, demand pulse delivery devices, and transtracheal oxygen delivery are oxygen-conserving devices that can improve the portability of oxygen therapy, reduce the overall costs of home oxygen therapy, especially in patients requiring higher flow rates, and can more effectively treat refractory hypoxemia. These devices function by delivering all of the oxygen during early inhalation. They reduce oxygen requirements by 25 to 75% compared to continuous flow oxygen. Disadvantages of these devices are that they are bulky on the face, mechanically more complicated, and require additional care as well as additional training of the user.

Evidence supporting this recommendation is of classes: C, D, M

COPD and Air Travel

Airline travel is safe for most patients with COPD. Hypoxemic patients should be evaluated clinically, and a decision should be made regarding oxygen requirements. Patients with COPD receiving continuous oxygen at home will require supplementation during flight. A doctor's order is required for patients who need supplemental oxygen during air travel. Special arrangements with oxygen or equipment suppliers and the airline must be made at least 48 hours prior to departure. Patients should check with airlines for restrictions and special arrangements that apply.

Evidence supporting this recommendation is of class: D

Use of Supplemental $O_2$ for Patients with COPD and Not Currently on Supplemental $O_2$

Regression equations have been validated which predict $pO_2$ at usual atmospheric pressures in aircraft. These predict that patients with $FEV_1$ <80% and $pO_2$ <80 will have in-flight $pO_2$ <55% and therefore should be prescribed supplemental $O_2$ at 2 L/M. Patients with underlying cardiovascular or cerebrovascular disease should be prescribed $O_2$ if their $FEV_1$ and $pO_2$ are even higher.

Evidence supporting this recommendation is of classes: D, R

15. Long-Term Management

Key Points:

- Obtaining the opinion of a pulmonary specialist may be beneficial at any stage of the disease.
- For patients with severe symptoms, despite maximal medical therapy, lung volume reduction surgery and transplantation may be an option. Referral to a pulmonologist should be made to evaluate candidacy.
- Physicians are encouraged to initiate and facilitate conversations about living wills and durable power of attorney for health care.

Schedule Regular Follow-Up Visits

Follow-up visits should be jointly established between primary care physicians and pulmonary specialists, and should be tailored to the learning stage and comorbidities of individual patients.

The exact frequency of clinician visits is a matter of clinical judgment; however, the following may serve as a general guide for patients with stable COPD.

Mild Severity: Follow-up yearly

Moderate Severity: Follow-up 3 to 6 months

Severe: Follow-up 2 to 4 months or more frequently as needed

### Evaluation and Monitoring of Comorbidities

In treating patients with COPD, it is important to consider the presence of concomitant conditions such as bronchial carcinoma, tuberculosis, sleep apnea, depression, osteoporosis, and heart failure. The appropriate diagnostic tools (chest radiograph, electrocardiogram, etc.) should be used whenever symptoms (e.g., hemoptysis) suggest one of these conditions.

### Refer to Pulmonary Specialist

Obtaining the opinion of a pulmonary specialist may be beneficial at any stage of the disease. Referral may be indicated to confirm the diagnosis, facilitate tobacco cessation, and optimize appropriate treatment.

Referral may be indicated:

- For patients under age 40 years or with a family history of emphysema or alpha$_1$-antitrypsin deficiency in order to identify the deficiency, treat, and screen family members
- To confirm diagnosis, rule out other etiologies, symptoms, complexities, and to optimize treatment
- If symptoms are not consistent with the lung function deficit as measured by pulmonary function tests
- For patient with frequent infections and/or possible bronchiectasis
- For assessment of long-term treatment with oral corticosteroids if results of steroid trial are unclear
- To identify and assess patients for possible lung volume reduction surgery or lung transplantation
- For patients with rapid decline in $FEV_1$ to optimize early intervention
- For patients with smoking history of less than 10 pack years to exclude/confirm diagnosis
- For patients with frequent exacerbations
- For patients who have been hospitalized for COPD

## Surgical Options for Severe Disease

### Lung Volume Reduction Surgery for Emphysema

The goal of lung volume reduction surgery (LVRS) is to relieve disabling dyspnea in patients in whom emphysema has limited activities of daily living and has proved refractory to optimal medical management. Following surgery, improvement has been noted in lung elastic recoil, respiratory function, ventilation/perfusion matching, and cardiovascular function. A variety of surgical approaches and reduction techniques have been used. Results of the National Emphysema Treatment Trial (NETT) have been published.

1. Overall, LVRS did not demonstrate a survival advantage over medical therapy. LVRS only yielded a survival advantage for patients with

upper lobe emphysema and low baseline exercise capacity. LVRS demonstrated increased mortality and no functional improvement for patients with non-upper lobe emphysema.
2. LVRS only showed improvement in exercise capacity among a small subgroup of patients: those with upper lobe emphysema. Most patients' improvements returned to baseline after 2 years.
3. Significantly more patients with upper lobe emphysema randomized to LVRS had improved quality of life after 2 years as compared to non-surgical patients.
4. Due to the strictness of the exclusion criteria, conclusions from the NETT trial cannot be extended to the general population of patients with emphysema.
5. Pre-operative evaluation includes ability to complete a 6-minute walk of over 140 meters, completion of a pulmonary rehabilitation program, full pulmonary function tests, chest computed tomography (CT), echocardiogram, and possibly a right heart catheterization and a radionuclide stress test.
6. LVRS should only be performed in medical centers with appropriately trained surgeons and availability of necessary equipment.

Evidence supporting this recommendation is of classes: A, R

Bullectomy

Giant bullous emphysema is a rare subset of patients in whom single or multiple large bullae encompass 30% or more of a hemithorax, often displacing potentially functional lung tissue as these large airspaces increase in volume. In appropriate cases, surgical resection of these bullae can restore significant pulmonary function and improve symptoms. CT scan is essential in evaluating these patients and referral to a pulmonary specialist is indicated.

Evidence supporting this recommendation is of class: D

Lung Transplantation

Unilateral or bilateral lung transplantation is a treatment option in highly selected patients with severe COPD. A few studies show improvement in quality of life parameters but no increase of survivability.

General selection guidelines for candidate selection for lung transplantation in COPD patients

Relative Contraindications

- Age limits:
    - Heart-lung transplants: approximately 55 yrs
    - Double lung transplant: approximately 60 yrs
    - Single lung transplant: approximately 65 yrs
- Symptomatic osteoporosis
- Oral corticosteroids >20 mg day-1 prednisone
- Psychosocial problems

- Requirement for invasive mechanical ventilation

Absolute Contraindications

- Severe musculoskeletal disease affecting the thorax
- Substance addiction within previous 6 months
- Dysfunction of extrathoracic organ, particularly renal dysfunction
- HIV infection
- Active malignancy within 2 years except basal or squamous cell carcinoma of skin
- Hepatitis B antigen positive
- Hepatitis C with biopsy-proven evidence of liver disease

Following the position of the American Thoracic Society and the European Respiratory Society, appropriate candidate selection is as follows:

- $FEV_1$ less than or equal to 25% predicted (without reversibility) and/or
- Resting room air $PaCO_2$ greater than 55 mm Hg and/or
- Elevated $PaCO_2$ with progressive deterioration requiring long-term oxygen therapy
- Elevated pulmonary arterial pressure with progressive deterioration

For further information, the guideline developers recommend review of the American Thoracic Society COPD management recommendations at www-test.thoracic.org/COPD/10/surgery_for_copd.asp.

Evidence supporting this recommendation is of classes: C, R

Discuss Health Care Directives (Advance Directives) or Living Will and Durable Power of Attorney for Health Care

Many patients have an interest in discussing living wills but their wishes tend to be passive and unspoken.

Physicians are encouraged to initiate and facilitate conversations about living wills with all COPD patients at routine outpatient visits.

In patients with severe disease, it is also helpful to discuss specific treatment preferences.

Treatment preferences may include home care only, hospitalization for comfort care, initiation full life support if there is a reasonable chance for recovery to functional independence, or continuation of indefinite life support in a chronic nursing facility.

Objectives of Discussion

1. To encourage physicians to discuss health care directives with COPD patients
2. To give patients control over their end-of-life care decisions

3. To ensure that patients' wishes will be carried out at the end of their life
4. To increase the number of COPD patients who have written health care directives
5. To increase the number of patients with severe COPD who have discussed specific treatment preferences and goals of care
6. To name a Durable Power of Attorney for Health Care or an appropriate surrogate decision maker

Plan for Discussion

- For the patient with moderate to severe COPD, at a routine office visit, ask the question, "Do you have a living will?"

  Action: If yes, ask what it consists of (especially whether there is a designation of durable power of attorney and who that person is) and request that a copy be placed in the patient's medical record.

  Action: If no, offer the patient written information on health care directives, encourage them to fill out a health care directive including designation of power of attorney for health care, and offer to discuss any questions at the next office visit.

- For the patient with severe COPD, at a routine office visit ask the question, "What are your treatment preferences in regards to hospitalization, life support (including cardiopulmonary resuscitation [CPR], endotracheal intubation and non-invasive ventilation), and end-of-life care?"

  Action: Encourage the patient to discuss these treatment preferences with family or health care surrogate and record them in a health care directive.

  Action: Document the patient's treatment preferences in the patient's medical record and request that a copy of the health care directive be placed in the patient's medical record.

Evidence supporting this recommendation is of classes: D, R

Definitions:

Conclusion Grades:

Grade I: The evidence consists of results from studies of strong design for answering the question addressed. The results are both clinically important and consistent with minor exceptions at most. The results are free of any significant doubts about generalizability, bias, and flaws in research design. Studies with negative results have sufficiently large samples to have adequate statistical power.

Grade II: The evidence consists of results from studies of strong design for answering the question addressed, but there is some uncertainty attached to the conclusion because of inconsistencies among the results from the studies or because of doubts about generalizability, bias, research design flaws, or adequacy of sample size. Alternatively, the evidence consists solely of results from weaker designs for the question addressed, but the results have been confirmed in separate studies and are consistent with minor exceptions at most.

Grade III: The evidence consists of results from studies of strong design for answering the question addressed, but there is substantial uncertainty attached to the conclusions because of inconsistencies among the results from different studies or because of serious doubts about generalizability, bias, research design flaws, or adequacy of sample size. Alternatively, the evidence consists solely of results from a limited number of studies of weak design for answering the question addressed.

Grade Not Assignable: There is no evidence available that directly supports or refutes the conclusion.

Classes of Research Reports:

A. Primary Reports of New Data Collection:

Class A:

- Randomized, controlled trial

Class B:

- Cohort study

Class C:

- Nonrandomized trial with concurrent or historical controls
- Case-control study
- Study of sensitivity and specificity of a diagnostic test
- Population-based descriptive study

Class D:

- Cross-sectional study
- Case series
- Case report

B. Reports that Synthesize or Reflect upon Collections of Primary Reports:

Class M:

- Meta-analysis
- Systematic review
- Decision analysis
- Cost-effectiveness analysis

Class R:

- Consensus statement
- Consensus report
- Narrative review

Class X:

- Medical opinion

### CLINICAL ALGORITHM(S)

A detailed and annotated clinical algorithm is provided for Chronic Obstructive Pulmonary Disease.

## EVIDENCE SUPPORTING THE RECOMMENDATIONS

### TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of supporting evidence is classified for selected recommendations (see "Major Recommendations").

In addition, key conclusions contained in the Work Group's algorithm are supported by a grading worksheet that summarizes the important studies pertaining to the conclusion. The type and quality of the evidence supporting these key recommendations (i.e., choice among alternative therapeutic approaches) is graded for each study.

## BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

### POTENTIAL BENEFITS

Accurate diagnosis, evaluation of severity, and effective management of patients presenting with symptoms of stable chronic obstructive pulmonary disease (COPD)

### POTENTIAL HARMS

#### Adverse Effects of Medication

- Theophylline may cause gastrointestinal irritation (nausea, dyspepsia, and gastroesophageal reflux disease [GERD]), irritability, tremor, and sleep disturbance. Theophylline has a narrow therapeutic index with potentially significant adverse effects and drug interactions that must be carefully considered and closely monitored for during therapy.
- Tremor can develop with high doses of albuterol and salmeterol.
- Steroid side effects, especially with oral corticosteroid use

#### Adverse Effects of Surgical Procedures

- Lung volume reduction surgery demonstrated increased mortality and no functional improvement for patients with non-upper lobe emphysema.
- Perioperative mortality, rejection, bronchiolitis obliterans, cytomegalovirus, fungal and bacterial infections, and lymphoproliferative disease are associated with transplant surgery, as well as high initial and on-going immunosuppressive regimen costs

## CONTRAINDICATIONS

### CONTRAINDICATIONS

#### Relative Contraindications for Participation in Pulmonary Rehabilitation

- Patients with conditions that might interfere with the patient undergoing a rehabilitation program (e.g., coronary artery disease, cognitive impairment interfering with learning, severe psychiatric disturbances)
- Patients with conditions that might place the patient at risk during exercise training; many patients with chronic obstructive pulmonary disease (COPD) are older with a history of cigarette smoking and are at risk for heart disease. Cardiac and pulmonary stress testing should be routinely performed to exclude silent cardiac disease and assure safety during exercise training.

#### Relative Contraindications for Lung Transplantation

- Age limits:
  - Heart-lung transplants: approximately 55 years
  - Double lung transplant: approximately 60 years
  - Single lung transplant: approximately 65 years
- Symptomatic osteoporosis
- Oral corticosteroids > 20 mg day-1 prednisone
- Psychosocial problems
- Requirement for invasive mechanical ventilation

#### Absolute Contraindications for Lung Transplantation

- Severe musculoskeletal disease affecting the thorax
- Substance addiction within previous 6 months
- Dysfunction of extrathoracic organ, particularly renal dysfunction
- HIV infection
- Active malignancy within 2 years except basal or squamous cell carcinoma of skin
- Hepatitis B antigen positive
- Hepatitis C with biopsy-proven evidence of liver disease

## QUALIFYING STATEMENTS

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- These clinical guidelines are designed to assist clinicians by providing an analytical framework for the evaluation and treatment of patients, and are not

intended either to replace a clinician's judgment or to establish a protocol for all patients with a particular condition. A guideline will rarely establish the only approach to a problem.
- This clinical guideline should not be construed as medical advice or medical opinion related to any specific facts or circumstances. Patients are urged to consult a health care professional regarding their own situation and any specific medical questions they may have.

## IMPLEMENTATION OF THE GUIDELINE

### DESCRIPTION OF IMPLEMENTATION STRATEGY

Once a guideline is approved for general implementation, a medical group can choose to concentrate on the implementation of that guideline. When four or more groups choose the same guideline to implement and they wish to collaborate with others, they may form an action group.

In the action group, each medical group sets specific goals they plan to achieve in improving patient care based on the particular guideline(s). Each medical group shares its experiences and supporting measurement results within the action group. This sharing facilitates a collaborative learning environment. Action group learnings are also documented and shared with interested medical groups within the collaborative.

Currently, action groups may focus on one guideline or a set of guidelines such as hypertension, lipid treatment, and tobacco cessation.

Detailed measurement strategies are presented in the original guideline document to help close the gap between clinical practice and the guideline recommendations. Summaries of the measures are provided in the National Quality Measures Clearinghouse (NQMC).

#### Key Implementation Recommendations

The following system changes were identified by the guideline work group as key strategies for health care systems to incorporate in support of the implementation of this guideline.

1. A model of patient education should be established in the clinics based upon individual learning needs assessments and including coordinated plans jointly developed by educators, patients, and their families. Patient education should include core learning and needs objectives based upon individual needs.
2. Include chronic obstructive pulmonary disease (COPD) patients in a system of patient visit planning for establishing tobacco status at each visit and advice to quit if appropriate, as well as appropriate pharmacotherapy and assessment of hypoxemia.

### IMPLEMENTATION TOOLS

Clinical Algorithm
Pocket Guide/Reference Cards
Quality Measures

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

### RELATED NQMC MEASURES

- Chronic obstructive pulmonary disease (COPD): percentage of patients with COPD whose physician inquired about smoking cessation (if patient a smoker) at every visit.

## INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

### IOM CARE NEED

End of Life Care
Getting Better
Living with Illness

### IOM DOMAIN

Effectiveness
Patient-centeredness

## IDENTIFYING INFORMATION AND AVAILABILITY

### BIBLIOGRAPHIC SOURCE(S)

Institute for Clinical Systems Improvement (ICSI). Chronic obstructive pulmonary disease. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2005 Dec. 66 p. [122 references]

### ADAPTATION

Not applicable: The guideline was not adapted from another source.

### DATE RELEASED

2001 Dec (revised 2005 Dec)

### GUIDELINE DEVELOPER(S)

Institute for Clinical Systems Improvement - Private Nonprofit Organization

### GUIDELINE DEVELOPER COMMENT

Organizations participating in the Institute for Clinical Systems Improvement (ICSI): Affiliated Organizations participating in the Institute for Clinical Systems Improvement (ICSI): Affiliated Community Medical Centers, Allina Medical Clinic, Altru Health System, Aspen Medical Group, Avera Health, CentraCare, Columbia Park Medical Group, Community-University Health Care Center, Dakota Clinic, ENT Specialty Care, Fairview Health Services, Family HealthServices Minnesota, Family Practice Medical Center, Gateway Family Health Clinic, Gillette Children's Specialty Healthcare, Grand Itasca Clinic and Hospital, HealthEast Care System, HealthPartners Central Minnesota Clinics, HealthPartners Medical Group and Clinics, Hutchinson Area Health Care, Hutchinson Medical Center, Lakeview Clinic, Mayo Clinic, Mercy Hospital and Health Care Center, MeritCare, Mille Lacs Health System, Minnesota Gastroenterology, Montevideo Clinic, North Clinic, North Memorial Care System, North Suburban Family Physicians, Northwest Family Physicians, Olmsted Medical Center, Park Nicollet Health Services, Pilot City Health Center, Quello Clinic, Ridgeview Medical Center, River Falls Medical Clinic, Saint Mary's/Duluth Clinic Health System, St. Paul Heart Clinic, Sioux Valley Hospitals and Health System, Southside Community Health Services, Stillwater Medical Group, SuperiorHealth Medical Group, University of Minnesota Physicians, Winona Clinic, Ltd., Winona Health

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## GUIDELINE COMMITTEE

Respiratory Steering Committee

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## FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

In the interest of full disclosure, the Institute for Clinical Systems Improvement (ICSI) has adopted a policy of revealing relationships work group members have with companies that sell products or services that are relevant to this guideline topic. The reader should not assume that these financial interests will have an adverse impact on the content of the guideline. Readers of the guideline may assume that only work group members listed below have potential conflict of interest to disclose.

No work group members have potential conflicts of interest to disclose.

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## GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Chronic obstructive pulmonary disease. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2004 Dec. 67 p.

## GUIDELINE AVAILABILITY

Electronic copies: Available from the Institute for Clinical Systems Improvement (ICSI) Web site.

Print copies: Available from ICSI, 8009 34th Avenue South, Suite 1200, Bloomington, MN 55425; telephone, (952) 814-7060; fax, (952) 858-9675; Web site: www.icsi.org; e-mail: icsi.info@icsi.org.

## AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- Chronic obstructive pulmonary disease. Executive summary. Bloomington (MN): Institute for Clinical Systems Improvement, 2005 Dec. 1 p. Electronic copies: Available from the Institute for Clinical Systems Improvement (ICSI) Web site.
- ICSI pocket guidelines. May 2005 edition. Bloomington (MN): Institute for Clinical Systems Improvement, 2005. 362 p.

Print copies: Available from ICSI, 8009 34th Avenue South, Suite 1200, Bloomington, MN 55425; telephone, (952) 814-7060; fax, (952) 858-9675; Web site: www.icsi.org; e-mail: icsi.info@icsi.org.

## PATIENT RESOURCES

None available

## NGC STATUS

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